~~SECRET~~ No. 3

Economic Intelligence Report

ALUMINUM IN THE SINO-SOVIET BLOC
1950–65

CIA/RR ER 61-45
November 1961

CENTRAL INTELLIGENCE AGENCY
Office of Research and Reports

~~SECRET~~

SECRET

Economic Intelligence Report

ALUMINUM IN THE SINO-SOVIET BLOC
1950–65

CIA/RR ER 61–45

WARNING

This material contains information affecting the National Defense of the United States within the meaning of the espionage laws, Title 18, USC, Secs. 793 and 794, the transmission or revelation of which in any manner to an unauthorized person is prohibited by law.

CENTRAL INTELLIGENCE AGENCY

Office of Research and Reports

SECRET

FOREWORD

The purpose of this report is to assess recent and projected developments in the aluminum industry of the Sino-Soviet Bloc, particularly (1) the achievements during 1950-60 in production of primary aluminum, alumina, and aluminum-bearing ore; (2) the prospects of fulfillment of the goals for production of aluminum in 1965; (3) the total investment and the average investment per unit of capacity in the aluminum industry of the Bloc; (4) the actual trend during 1950-60 and the probable trend during 1961-65 in the average cost of producing primary aluminum; and (5) the trade in aluminum between the Bloc and the Free World during recent years and the probable trend of that trade during 1961-65. 50X1

Because of the lack of data, two aspects of the aluminum industry of the Sino-Soviet Bloc have not been covered in this report: (1) production of secondary aluminum and (2) production of alumina and ore for use in the manufacture of commodities other than aluminum metal such as abrasives and ceramics.

CONTENTS

Appendixes

50X1

[redacted]

Tables

Map

ALUMINUM IN THE SINO-SOVIET BLOC*
1950-65

Summary and Conclusions

Production of aluminum in the Sino-Soviet Bloc increased from only 170,000 tons** in 1950 to nearly 1 million tons in 1960 -- an average annual rate of growth of about 19 percent. For comparison, production of aluminum in the Free World increased from about 1.3 million tons in 1950 to about 3.5 million tons in 1960 -- an average annual rate of about 11 percent. Of the total Bloc production of aluminum in 1960, the USSR and China contributed about 73 percent and 10 percent, respectively, and the European Satellites contributed the remainder.

The Bloc plans to continue the rapid increase in production of aluminum at least through 1965. If the plans are met, output in 1965 will be about 2 million tons. Each of the countries currently producing aluminum is planning to increase production, and some of these increases, particularly that planned for the USSR, are exceptionally large. During this period, Rumania hopes to join the ranks of the producing countries, leaving Albania and Bulgaria as the only European Satellites not producing aluminum. Output for 1960 and planned output for 1965 in each country of the Bloc are as follows:

	Thousand Tons	
Country or Area	1960	1965 Plan
USSR	700	1,400 to 1,500
Communist China	100	250
European Satellites	166	290 to 300
Hungary	49.5	55
Czechoslovakia	56	85
East Germany	35	55
Poland	26	75
Rumania	0	20 to 30
Total	970	2,000 to 2,100

* The estimates and conclusions in this report represent the best judgment of this Office as of 1 September 1961.

** Tonnages are given in metric tons throughout this report.

[redacted] the Bloc's chances of fulfilling the over-all goals for production of aluminum are good. The shortfalls that may occur in both Poland and Rumania are not expected to have any serious effect on the over-all relationship between demand and supply, and the probability that the production goals for 1965 will be achieved is strengthened by several positive considerations. First, reserves of ore in the Bloc as of January 1961 were large enough to support the expansion of production planned for 1961-65 and even a continued expansion after 1965. Second, the large supplies of electric power that will be needed for aluminum reduction probably will be available, even though the total production of electric power may fall short of the levels planned in some of the Bloc countries. Third, more intensive use of existing capacity, particularly in the USSR, should result in increased production. Fourth, the outlook for completion of the construction and modernization programs in the aluminum industry of the Bloc is considered to be generally favorable, with one important exception: construction of mining capacity in the USSR probably will lag. To offset any resulting deficits in production of ore, the USSR may import bauxite from Greece, as it has done during 1954-60, or initiate importing from countries such as Guinea and Ghana, where large reserves of high-grade bauxite exist. 50X1

In contrast to the practice of the Free World in using only bauxite as a commercial source of aluminum, the Bloc uses both bauxite and nonbauxite ores. In 1960, about 85 percent of the total output of aluminum in the Bloc was derived from bauxite and the remaining 15 percent from nonbauxite ores. By 1965 the share of the total derived from nonbauxite ores is planned to rise to nearly 30 percent. In the USSR, most of the production of aluminum will continue to be derived from bauxite ores, but the proportion from nonbauxite ores is to be increased. By 1965 the USSR plans to be using such nonbauxite ores as nepheline,* alunite,** and possibly sillimanite.*** All of the production of Communist China is to continue to come from indigenous nonbauxite ores, but the refineries of the European Satellites probably will be supplied almost entirely with Hungarian bauxite.

Although the content of alumina generally is much smaller and the content of reactive silica much larger in nonbauxite than in bauxite ores, the Bloc planners apparently feel that the consequent disadvantages are outweighed by a number of favorable factors. First, the enormous reserves of nonbauxite ores will support continued expansion of production for many years. Second, the deposits can be mined by low-cost strip methods. Third, the deposits, particularly in the USSR, usually are near comparatively inexpensive sources of fuel and power. Finally,

* A silicate of sodium, potassium, and aluminum.
** A hydrous sulfate of aluminum and potassium.
*** An aluminum silicate.

a substantial share of the total cost of producing alumina from nonbauxite ores is offset by the gain of valuable byproducts, such as raw materials for high-grade cement and caustic soda. These byproducts are recovered from the nonbauxite ores by newly developed technologies and are urgently needed for the continued expansion of the Bloc economies.

The expansion of capacity in the aluminum industry of the Bloc probably will require lower investment per unit of production during 1961-65 than in earlier years. This decrease in average investment would result mainly from economies associated with larger scale operations, such as larger strip mines, refineries, and smelters. Reductions in investment, however, probably will be less than planned in the USSR and Poland and possibly in other countries of the Bloc.

The rise in production of aluminum in the Bloc countries during 1961-65 is expected to be accompanied by a reduction in the average cost of production, thus continuing the general trend of 1950-60. In the USSR, average costs should decrease mainly because of investments in large, highly mechanized strip mines and in production equipment (particularly reduction cells) and rectifiers of advanced design and because of lower unit costs for fuel and power. Varying combinations of these factors, together with improvements in operating procedures, should contribute to reductions in the average cost of producing aluminum both in the European Satellites and in Communist China. The average cost of production, however, probably will not decrease as much as planned during 1961-65.

Because much larger supplies of aluminum will be needed to meet domestic demands, primarily to implement programs calling for the substitution of aluminum for costlier metals such as copper, the Bloc may cease to be a net exporter of aluminum some time during 1961-65. The USSR plans to increase substantially its consumption of aluminum, particularly in electric power transmission systems, during 1961-65. At the same time, the USSR plans to increase significantly its exports to the European Satellites, especially to East Germany. In Communist China, consumption of aluminum is expected to increase more rapidly than production. Thus the Bloc's principal exporter of aluminum to the West, the USSR, will have less aluminum for such exports during 1961-65, and the Bloc's principal importer of aluminum from the West, China, may have to continue importing from countries outside the Bloc. By the end of the period 1961-65, imports by the Bloc may exceed its exports.

I. Production

A. Aluminum

1. 1950-60

Production of primary aluminum by the Sino-Soviet Bloc expanded rapidly during 1950-60. From 170,000 tons in 1950, production increased at an average annual rate of about 19 percent to a total of about 970,000 tons in 1960. The rapid rise in total production during 1950-60 resulted mainly from the expansion of production in the USSR, Hungary, and East Germany, and the initiation and expansion of production in Czechoslovakia, Poland, and Communist China also contributed to the increase in total output. For data on production by the Bloc in selected years during 1950-60, see Table 1.*

Although the USSR remained the predominant producer of aluminum in the Bloc, the Soviet share of the total output by the Bloc decreased from about 90 percent in 1950 to 73 percent in 1960. The Chinese Communist share of the total output grew from 2 percent to 10 percent during 1955-60. Similarly, during 1950-60 the share of the European Satellites grew from about 10 percent to about 17 percent, with Hungary accounting for the largest share.

During 1950-60 the average annual rate of growth of production of primary aluminum was higher in the Bloc than in the Free World. As a result, the Bloc's share of the total world production grew from about 12 percent in 1950 to about 22 percent in 1960. Nevertheless, in absolute production the lead of the Free World widened substantially, as shown in Table 2.**

Output of primary aluminum by the Bloc in 1960 was produced in a relatively large number of reduction plants, many of which are very small in comparison with Western plants. In that year, about 50 reduction plants were in operation, including 10 in the USSR, 6 in the European Satellites, and probably more than 30 in Communist China. Among individual plants, the annual production ranged between 20,000 and 160,000 tons in the USSR, 10,000 and 56,000 tons in the European Satellites, and 1,000 and 40,000 tons in Communist China (see Table 7***).

In 1960 a few large plants contained the bulk of the reduction capacity in each region of the Bloc. About 70 percent of the total

* Table 1 follows on p. 6.
** Table 2 follows on p. 7.
*** P. 20, below.

Table 1

Production of Primary Aluminum in the Sino-Soviet Bloc a/
Selected Years, 1950-60, and 1965 Plan

Thousand Metric Tons

Country or Area	1950	1955	1958	1959	1960	1965 Plan
USSR	155	430	510	600	700	1,400 to 1,500
Communist China	0	10	50	70.4	100	250
European Satellites	17.5	108.5	122.3	144.6	166	290 to 300
Hungary	16.7	37.0	39.5	45.7	49.5	55
Czechoslovakia	0	24.4	26.4	41.0	56	85
East Germany	0.8	26.8	34.0	35.1	35	55
Poland	0	20.4	22.4	22.8	26	75
Rumania	0	0	0	0	0	20 to 30
Total	170	550	680	810	970	2,000 to 2,100

a. For the methodology, see Appendix A. Because of rounding, components may not add to the totals shown.

reduction capacity in the USSR was accounted for by four large plants, including two in the Urals and one each in the Volga and West Siberia Economic Regions. About 40 percent of the reduction capacity in China was represented by the plant at Fu-shun in Liaoning Province. Two plants, one in Czechoslovakia and the other in Poland, constituted about 55 percent of the reduction capacity in the European Satellites.

Table 2

Production of Primary Aluminum in the Sino-Soviet Bloc and the Free World a/
Selected Years, 1950-60

Thousand Metric Tons

Country or Area	1950	1955	1959	1960
Free World b/	1,290	2,580	3,230	3,500
US	652	1,420	1,772	1,828
Canada	360	556	544	691
Other	279	608	910	1,000
Sino-Soviet Bloc c/	170	550	810	970
USSR	155	430	600	700
Other	17.5	119	215	266
Total	1,460	3,130	4,040	4,500

a. Because of rounding, components may not add to the totals shown.

50X1

c. Data on production in the Bloc are taken from Table 1, p. 6, above.

2. 1961-65 Plans

Under current plans of the Bloc the rapid expansion of production of aluminum is to be continued during 1961-65. The goal for the total production in 1965, estimated to be from 2.0 million to 2.1 million tons, will necessitate an average annual rate of increase of about 16 percent during 1961-65. Although more moderate than the average rate of 19 percent that was achieved during 1950-60, the planned rate is an imposing one. The rise in total production is to be brought about by an increase

of 105 to 120 percent in Soviet production, 150 percent in Chinese Communist production, and about 75 to 80 percent in European Satellite production. For specific information on the planned output of aluminum in each country of the Bloc, see Table 1.*

B. Alumina and Ore

1. 1950-60

Production of alumina by the Bloc is estimated to have increased from about 350,000 tons in 1950 to about 2 million tons in 1960, a trend parallel to that in production of aluminum. The initiation and expansion of production of alumina by Communist China, East Germany, and Czechoslovakia took place during 1950-60, but the USSR remained the largest producer in the Bloc and Hungary the second largest. The Soviet and Hungarian shares of the total Bloc production, however, decreased appreciably. Data on production of alumina in the Bloc in selected years during 1950-60 are presented in Table 3.**

Although production and consumption of alumina were about equal for the Bloc as a whole in 1960, this situation was not true for individual Bloc countries. Hungarian production of alumina again, as in previous years, exceeded domestic requirements, and the surplus was used to supplement East German production and to satisfy all Polish requirements. In the USSR, Czechoslovakia, and Communist China, production apparently equaled requirements. Details on the distribution of the alumina produced in the Bloc in 1960 and planned for 1965 are shown in Table 4.***

In 1960, alumina was produced in a large number of plants in the Bloc, including 6 in the USSR, 5 in the European Satellites, and probably more than 20 in Communist China. A large part of the capacity in each of these countries of the Bloc, however, consisted of a very small number of plants. Two plants in the Urals Region made up about 70 percent of the total capacity in the USSR, the Almasfuzito Plant in Hungary accounted for 31 percent of the total capacity in the European Satellites, and the Nan-ting Plant represented 35 percent of the total capacity in Communist China, and these four plants constituted about 60 percent of the total capacity for producing alumina in the Bloc. Estimates of production of alumina in 1960 by selected plants in the Bloc are presented in Table 8,† and the locations of the plants are shown on the map.††

---

* P. 6, above.
** Table 3 follows on p. 9.
*** Table 4 follows on p. 10.
† P. 26, below.
†† Inside back cover.

Table 3

Production of Alumina in the Sino-Soviet Bloc a/
Selected Years, 1950-60, and 1965 Plan

Thousand Metric Tons

Country or Area	1950	1955	1958	1959	1960	1965 Plan
USSR	310	870	1,030	1,210	1,400	2,900 to 3,100
Communist China	0	30	110	140	200	500
European Satellites	34.4	200.3	221.2	330	390	520 to 540
Hungary	34.4	154.1	169.7	191.6	218	250
Czechoslovakia	0	0	0	80	110	170
East Germany	0	46.2	51.5	55.3	60	60
Rumania	0	0	0	0	0	40 to 60
Total	350	1,100	1,400	1,700	2,000	4,000 to 4,100

a. For the methodology, see Appendix A. Because of rounding, components may not add to the totals shown.

Table 4

Origin and Distribution of Alumina in the Sino-Soviet Bloc a/
1960 and 1965 Plan

Thousand Metric Tons

Year	Country or Area	Origin				Distribution			
			Imports				Exports		
		Production b/	From Hungary c/	From the USSR c/	Total Supply	Internal Use	To Bloc Countries	To Non-Bloc Countries	Production as a Percent of Internal Use
1960	USSR	1,400	0		1,400	1,400	0	0	100
	Communist China	200	0	0	200	200	0	0	100
	European Satellites	390		0	390	330		59	118
	Hungary	218		0	218	97	62 d/	59 d/	224
	East Germany	60	12	0	72	72	0	0	83
	Czechoslovakia	110	0	0	110	110	0	0	100
	Poland	0	50	0	50	50	0	0	0
	Total	2,000			2,000	1,920		59 d/	104
1965 Plan	USSR	2,900 to 3,100	0		2,900 to 3,100	2,900 to 3,100	60		100
	Communist China	500	0	0	500	500	0		100
	European Satellites	520 to 540		60	580 to 600	580 to 600			90
	Hungary	250	0	0	250	110	140		228
	East Germany	60	50	0	110	110	0		55
	Czechoslovakia	170	0	0	170	170	0		100
	Poland	0	90	60	150	150	0		0
	Rumania	40 to 60	0	0	40 to 60	40 to 60	0		100
	Total	4,000 to 4,100			4,000 to 4,100	4,000 to 4,100			100

a. Because of rounding, components may not add to the totals shown.
b. Data shown in this column are taken from Table 3, p. 9, above.
c. The data shown in these columns for 1960 represent the difference between production of alumina and the total quantity of alumina that was required to achieve the level of production of primary aluminum in 1960 in the respective countries. Actual imports of alumina, however, may have varied somewhat from those levels. The figures shown for 1965 are based on the requirements indicated by the planned levels of production of aluminum and alumina in the respective countries.
d. Of Hungary's total export of 121,000 tons of alumina in 1960, 3/ the estimated quantity exported to Bloc countries is the sum of the figures shown in Column 2, and the quantity exported to non-Bloc countries is the residual.

During 1950-60, production of aluminum-bearing ore in the Bloc expanded rapidly but not so rapidly as requirements. By 1960, as shown in Table 5,* the total production of ore in the Bloc was about 6.4 million tons, or about 280 percent more than production in 1950. Beginning in 1954, however, the Bloc supplemented domestic production with imports in order to meet total requirements. These imports, consisting entirely of Soviet imports of bauxite from Greece, averaged about 310,000 tons annually during 1954-60. Imports for each year, in thousands of tons, were as follows**:

1954	1955	1956	1957	1958	1959	1960
12	122	306	405	450	454	432

These imports represented about 3 percent of the total supply of ore in the Bloc in 1955 and 6 percent in 1960. Estimates of the origin and distribution of the supply of ore in the Bloc in 1960 are shown in Table 6.***

The capacity for mining ore in the Bloc in 1960 consisted mainly of large underground bauxite mines in the Ural Mountains in the USSR and in northwestern Hungary. Most of the remaining capacity consisted of strip mines that are located primarily in Communist China.† The locations of the principal mines are shown on the map.††

The variety of ores used by the Bloc for producing alumina expanded during 1950-60, as shown in Table 5.* Whereas in 1950 bauxite was the only type of ore processed into alumina, by 1960 several other ores also were processed. In the USSR, 100 percent of the alumina produced was derived from bauxite in 1950, but in 1960 only 92 percent was derived from this ore. All of the alumina produced in China during this period was derived from shale and clay. The Soviet nepheline concentrate and the Chinese shale and clay together made up about 16 percent of the total supply of ore used by the Bloc for producing alumina in 1960.

Measured in terms of weight, nonbauxite ores generally are inferior to bauxite because their content of alumina is smaller††† and‡

* Table 5 follows on p. 12.

50X1

*** Table 6 follows on p. 13.

† The coordinates of these mines are unknown.

†† Inside back cover.

††† An important exception is China's shale and clay, apparently with an alumina content about as large as that for commercial bauxite.

‡ Text continued on p. 14.

Table 5

Production of Aluminum-Bearing Ore in the Sino-Soviet Bloc a/
Selected Years, 1950-60, and 1965 Plan

Thousand Metric Tons

Country or Area	Type of Ore	1950	1955	1958	1959	1960	1965 Plan
USSR	Bauxite	1,100	2,600	3,000	3,500	4,100	8,000 to 9,000
	Nepheline concentrate b/	0	120	160	320	400	3,000
	Other c/	0		0	0	0	
Total USSR		1,100	2,700	3,200	3,800	4,500	11,000 to 12,000
Communist China	Shale and clay	0	110	390	490	700	1,700
European Satellites		577.8	1,241	1,053	956.7	1,189	1,650 to 1,720
Hungary	Bauxite	577.8	1,241	1,053	956.7	1,189	1,510
Rumania	Bauxite	0	0	0	0	0	140 to 210
Total		1,700	4,100	4,600	5,300	6,400	14,500 to 15,500

a. For the methodology, see Appendix A. Because of rounding, components may not add to the totals shown.
b. This material is a byproduct obtained by the mineral fertilizer industry from processing of apatite-nepheline ore.
c. Including nepheline, nepheline syenite, and alunite.

Table 6

Origin and Distribution of Aluminum-Bearing Ore in the Sino-Soviet Bloc a/
1960 and 1965 Plan

Thousand Metric Tons

Year	Country or Area	Origin				Distribution		
			Imports					
		Production b/	From Hungary c/	From Greece	Total Supply	Internal Use d/	Exports to Bloc Countries	Production as a Percent of Internal Use
1960	USSR	4,500	0	432 e/	4,900	4,900	0	91
	Communist China	700	0	0	700	700	0	100
	European Satellites	1,189		0	1,189	1,189		100
	Hungary	1,189		0	1,189	690	499 f/	172
	East Germany	0	170	0	170	170	0	0
	Czechoslovakia	0	330	0	330	330	0	0
	Total	6,400		432	6,800	6,800		94
1965 Plan	USSR	11,000 to 12,000	0	N.A. g/	11,000 to 12,000	11,000 to 12,000	0	100
	Communist China	1,700	0	0	1,700	1,700	0	100
	European Satellites	1,650 to 1,720		0	1,650 to 1,720	1,650 to 1,720		100
	Hungary	1,510		0	1,510	810	700	186
	East Germany	0	200	0	200	200	0	0
	Czechoslovakia	0	500	0	500	500	0	0
	Rumania	140 to 210	0	0	140 to 210	140 to 210	0	100
	Total	14,500 to 15,500		N.A.	14,500 to 15,500	14,500 to 15,500		100

a. Because of rounding, components may not add to the totals shown.
b. Data in this column are taken from Table 5, p. 12, above.
c. The figures in this column represent the approximate quantities of ore required by the importing countries for the production of alumina shown in Table 3, p. 9, above.
d. The figures in this column represent the approximate quantities of ore required for the production of alumina shown in Table 3.
e. 6/
f. 7/
g. The USSR may continue to import ore from Greece until 1965, but there is no evidence of present plans for such imports.

because their content of reactive silica is greater. For each part of reactive silica content, 1 to 2 parts of alumina and 0.7 to 1.75 parts of caustic soda, an important input, are lost during processing. Thus, compared with bauxite, for each unit of alumina obtained from a nonbauxite ore the quantity of ore processed is greater, the recovery of alumina is smaller, and the loss of soda is greater.

The conventional methods used for producing alumina from bauxite -- for example, the Bayer process, the modified Bayer process, and the lime-soda-sinter process -- are not suitable for processing ores that contain as much reactive silica as is found in the nonbauxite ores used by the USSR and Communist China. Introduction of the nonbauxite ores followed the development of new processing techniques in the USSR and (with Soviet aid) in Communist China. The use of these new techniques results in production not only of alumina but also of large quantities of such byproducts as soda, potash, and raw materials for producing cement and bricks. Proceeds from the sale of these byproducts are reported to offset a large share of the higher cost of producing alumina from nonbauxite ores.

2. 1961-65 Plans

Achievement of the estimated goal for production of aluminum in the Bloc in 1965 would require about 4.0 million to 4.1 million tons of alumina, or about twice the quantity produced in 1960. Consequently, the USSR plans to increase its output of alumina by about 110 to 120 percent, China by about 150 percent, Czechoslovakia by 55 percent, and Hungary by 15 percent, and Rumania hopes to begin producing alumina during the period. East German plans are somewhat more modest -- production in 1965 is to be at about the level achieved in 1960 (see Table 3*).

If these goals are achieved, the proportional distribution of the total production by the Bloc in 1965 will be roughly the same as it was in 1960. The only important exception is that Communist China will be the second largest (after the USSR) and Hungary the third largest producer of alumina in the Bloc, or the reverse of their relative standings in 1960. Furthermore, the USSR and Hungary will have enough alumina not only to satisfy their own requirements and those of Poland but also to supplement the production of East Germany, and Communist China, Czechoslovakia, and Rumania will have enough to satisfy their own requirements (see Table 4**).

Assuming that the Bloc intends to rely on domestic production for supplies of ore, the goal for the total production of ore by the Bloc in 1965 should be about 14 million to 15 million tons, or about 130 to 140 percent above production in 1960. The European Satellites

* P. 9, above.
** P. 10, above.

will continue to use only bauxite, and Communist China only shale and clay, for producing alumina. The USSR, however, plans to expand the variety of ores used to include not only bauxite and nepheline concentrate, as was the case in 1960, but also nepheline, nepheline syenite, alunite, and possibly sillimanite also. By 1965, nonbauxite ores may account for more than 20 percent of the total supply of ore in the USSR and more than 30 percent of that in the Bloc. The share of the total production of aluminum based on nonbauxite ore, however, will be somewhat smaller than 30 percent (see Table 5*).

II. Prospects for 1961-65

Production of primary aluminum probably will expand about as rapidly as planned during 1961-65 in each of the countries of the Sino-Soviet Bloc, except perhaps for minor shortfalls in Poland and Rumania, and thus the total production by the Bloc in 1965 should be about 2.0 million to 2.1 million tons as planned. All supplies of alumina required for this output probably will originate within the Bloc, but some ore may be imported by the USSR from countries outside the Bloc.

Several main factors are involved in the probable expansion of Bloc production of aluminum during 1961-65. First, the reserves of ore in the Bloc as of January 1961 apparently were large enough to support the expansion of production planned for 1961-65 and even for continued expansion after 1965. Second, the large additional supplies of electric power that will be needed for aluminum reduction during 1961-65 should be available. Third, most of the construction and modernization of facilities planned probably will be completed during the period. Finally, the USSR probably will continue to make progress in the more efficient and intensive use of existing capacity.

A. Reserves of Ore

1. Current Reserves

a. USSR

The largest reserves of aluminum-bearing ores in the Bloc as of January 1961 were in the USSR. The total Soviet reserves probably include about 600 million tons of bauxite.** According to available data, the aluminum metal contained in these reserves of bauxite is about 80 million tons, or 110 to 120 times the quantity of aluminum produced by the USSR in 1960. The reserves also include several low-quality nonbauxite

* P. 12, above.

50X1

ores such as nepheline, alunite, and sillimanite, and the aluminum metal content of these latter reserves combined probably is several times that of the reserves of bauxite. 10/

The Soviet reserves are dispersed among many regions. The general locations of the principal deposits are as follows*:

Type of Ore	Location of Deposits 11/
Bauxite	Boksitogorsk, Leningradskaya Oblast, RSFSR
Bauxite	Salair, Kemerovskaya Oblast, RSFSR
Bauxite	Sverdlovskaya Oblast, RSFSR
Bauxite	Turgay, Kazakh SSR
Apatite-nepheline	Kola Peninsula, Murmanskaya Oblast, RSFSR
Nepheline	Uzhur, Krasnoyarskiy Kray, RSFSR
Nepheline syenite	Pavlodarskaya Oblast, Kazakh SSR
Nepheline syenite	Akmolinskaya Oblast, Kazakh SSR
Nepheline	Kiya Shaltyr, Kemerovskaya Oblast, RSFSR
Nepheline syenite	Akhtinskiy Rayon, Armenian SSR
Alunite	Zaglik, Azerbaydzhan SSR
Sillimanite	Kyakhta, Buryatskaya ASSR

b. European Satellites

Additional reserves of aluminum-bearing ore are found in the European Satellites. As of January 1961, these reserves appeared to be large enough to support the expansion of the European Satellite aluminum industry planned for 1961-65. The major examples are the deposits of bauxite in Hungary, which according to an official estimate, totaled 115 million tons in 1960, 12/ and the principal deposits are concentrated in the Bakony and Vertes Mountains in the western part of the country. 13/ Additional reserves of bauxite, estimated to be about 20 million tons, are located in Rumania. 14/ The average quality of the Hungarian bauxite probably is higher than that of the Rumanian bauxite.

East Germany, Poland, and Czechoslovakia apparently do not have reserves of aluminum-bearing ores of commercial value. Each has deposits of low-grade shale and clay but lacks the technologies needed for economical production. An attempt to develop such a technology in East Germany was recently abandoned. 15/ A similar attempt is now underway in Poland, 16/ but the outlook for success during 1961-65 is unfavorable.

The reserves in Hungary, however, are large enough to support the planned expansion of the entire European Satellite aluminum

* These locations are shown on the map, inside back cover.

industry in 1961-65. The estimated reserves in 1960 were about 100 times as large as the quantity of bauxite used during that year by Hungary, East Germany, Poland, and Czechoslovakia together.

c. Communist China

Finally, China also has reserves of aluminum-bearing ores that appear to be large enough to support the expansion of the Chinese aluminum industry planned for 1961-65. Reserves of aluminum-bearing shale and clay in China as of 1958 were estimated to be "several billion tons." 17/ If this estimate is assumed to mean about 3 billion tons, the aluminum content of Chinese reserves would be about 700 million tons, or hundreds of times as much as the planned production for 1961-65.

In Communist China, major deposits of shale and clay are located in Liaoning, Hopeh, Shantung, Shansi, Anhwei, Chekiang, Kweichow, Szechwan, Yunnan, and Shensi, and there are additional deposits of unknown size in Tsinghai, Kansu, and Sinkiang. 18/ These locations are shown on the map.*

2. Future Reserves

Proved reserves of aluminum-bearing ores in the Sino-Soviet Bloc, particularly the nonbauxite ores in the USSR and Communist China, probably will increase during 1961-65. Further geological exploration will result in additional known reserves, and advances in the technology of producing alumina, resulting in a broadening of the grades and types of ore that can be processed economically, could, in effect, also increase reserves. Advances in technology also may result in an increase in the proportion of alumina that is recoverable from ore. Such advances in technology occurred during 1950-60, and similar advances can be anticipated during 1961-65.

B. Supply of Electric Power

The expansion in production of aluminum planned by the Bloc for 1961-65 probably will not be retarded by shortages of electric power. The aluminum reduction plants to be expanded or constructed during 1961-65 generally are situated fairly close to hydroelectric or thermoelectric powerplants that are to be expanded or constructed during that period. These powerplants should be adequate to supply the large additional quantities of electric power that will be needed both by the aluminum reduction plants and by other important consumers. The outlook appears to be particularly favorable in the USSR, where, for example, the aluminum industry will be able to obtain large quantities of power from powerplant

* Inside back cover.

developments at or near Stalingrad, Pavlodar, Krasnoyarsk, and Irkutsk. The European Satellites and China may not succeed in expanding production of electric power during 1961-65 as rapidly as planned. In spite of possible shortfalls in production of electric power in these areas, however, most of the requirements of the aluminum industry probably will be met.

Furthermore, during 1961-65 the task of supplying the electric power needed by the aluminum industry of the Bloc should be eased somewhat, particularly in the USSR, because the growth in the total consumption of power by the aluminum industry probably will not be so great as the growth in the total production of aluminum. The introduction of more efficient reduction cells and rectifiers in Soviet and European Satellite plants and the more extensive application of improved operating procedures throughout the aluminum industry of the Bloc should result in a reduction in the average quantity of electric power consumed per unit of aluminum produced.

C. Expansion of Capacity

1. Construction Plans

a. Aluminum Reduction

During 1961-65, new capacity for the reduction of primary aluminum in the Bloc is to be added mainly through the construction of new plants. Of the total planned increment in production, about 85 percent, or about 820,000 to 930,000 tons, is to be obtained from new capacity,* of which about 65 percent is represented by new plants and the remainder by expansion and modernization of existing plants. Most of the new plants planned are large compared with existing plants in the Bloc, and the predominant share of capacity to be added to existing plants is earmarked for the largest plants. Except in Communist China, plans call for the installation of advanced production and auxiliary equipment and for extensive introduction of mechanization and automation.

Soviet plans for 1961-65 provide for the addition of about 600,000 to 700,000 tons of new reduction capacity, or about three-fourths of the total planned for the Bloc. Four new reduction plants under construction in the USSR constitute about three-fourths of the total new capacity planned for the entire country. These plants are at Pavlodar in Kazakh SSR; at Myski in West Siberia; and at Krasnoyarsk in Krasnoyarskiy Kray and Shelekhovo in Irkutskaya Oblast, both in East

* Of the remaining 15 percent, about one-half is to be obtained from more intensive use of existing capacity (see D, p. 31, below) and the remainder from new capacity brought into operation during 1960.

Siberia, as shown on the map.* The remaining one-fourth of the total will consist of additions to capacity at existing plants, most of which are to take place at the four largest plants in the country, which include the two reduction plants in the Urals and the plants at Stalinsk and Stalingrad. If current plans are realized, these plants together with the four new plants will produce nearly 80 percent of the total Soviet production of primary aluminum in 1965, as shown in Table 7.**

Complete information on the type of equipment to be installed in the new plants and on the additions to capacity at existing plants is not available, but the attention that the Soviet press has devoted to the size of the reduction cells and the type of rectifiers*** suggests that these are important elements. According to Soviet plans, the cells are designed to operate at current loads of 120,000 to 130,000 amperes 19/ and should have an annual output of about 300 to 320 tons† each, whereas cells in use at many of the existing plants range in size from 40,000 to 80,000 amperes†† and have an annual output of only 100 to 200 tons. Moreover, a very large experimental cell, designed to operate at 150,000 amperes 22/ and to produce about 375 tons of aluminum annually, may be installed in reduction lines late in the current planning period. Installation of improved mercury-arc rectifiers and semiconductor rectifiers, both of which are more efficient than the converters and rectifiers now in use at many plants, also is planned. 23/

Expansion of the capacities of existing Soviet reduction plants is to be achieved not only by construction of new reduction lines but also by modernization measures designed to increase the current load at which the existing reduction lines operate. The Dnepr Aluminum Plant in the Ukraine, for example, proposes to effect measures whereby the current load on existing lines will be raised 20 percent, resulting in a corresponding increase in output. 24/

The Soviet program also includes plans for high levels of mechanization and automation at new plants and for their more extensive application at existing plants. 25/ The object of these measures is to increase the productivity of labor, thus reducing labor costs and†††

---

* Inside back cover.

** Table 7 follows on p. 20.

*** These are devices used for converting alternating current (AC) to direct current (DC).

† Output per cell-year is calculated by using the approximate ratio of 2.5 tons to 1,000 amperes.

50X1

††† Text continued on p. 23.

Table 7

Production of Aluminum in the Sino-Soviet Bloc, by Plant a/
1960 and 1965 Plan

Thousand Metric Tons

Country	Economic Region b/	Plant	Location c/	1960	1965 Plan
USSR	Ia (Northwest)	Kandalaksha Aluminum Plant	Kandalaksha, Murmanskaya Oblast	30	30
		Nadvoytsy Aluminum Plant	Nadvoytsy, Karelian ASSR	30 d/	40
		Volkhov Aluminum Plant	Volkhov, Leningradskaya Oblast	20	30
	III (South)	Dnepr Aluminum Plant	Zaporozh'ye, Zaporozhskaya Oblast, Ukrainian SSR	70	100
	V (Transcaucasus)	Sumgait Aluminum Plant	Sumgait, Azerbaydzhan SSR	40 e/	60
		Kanaker Aluminum Plant	Yerevan, Armenian SSR	40	50
	VI (Volga)	Stalingrad Aluminum Plant	Stalingrad, Stalingradskaya Oblast	80 f/	150
	VIII (Urals)	Bogoslovskiy Aluminum Plant	Krasnotur'insk, Sverdlovskaya Oblast	120	150
		Urals Aluminum Plant	Kamensk-Ural'skiy, Sverdlovskaya Oblast	110	150
	IX (West Siberia)	Stalinsk Aluminum Plant	Stalinsk, Kemerovskaya Oblast	160 g/	200
		Myski Aluminum Plant	Myski, Kemerovskaya Oblast	0 h/	100
	Xa (Kazakhstan)	Pavlodar Aluminum Plant	Pavlodar, Pavlodarskaya Oblast, Kazakh SSR	0 h/	140
	XI (East Siberia)	Irkutsk Aluminum Plant	Shelekhovo, Irkutskaya Oblast	0 h/ i/	160
		Krasnoyarsk Aluminum Plant	Krasnoyarsk, Krasnoyarskiy Kray	0 h/	100
		Total, USSR		700	1,400 to 1,500

Table 7

Production of Aluminum in the Sino-Soviet Bloc, by Plant a/
1960 and 1965 Plan
(Continued)

Thousand Metric Tons

Country	Plant	Location	1960	1965 Plan
Communist China	Fu-shun Aluminum Plant	Fu-shun, Liaoning Province	40	40
	Lan-chou Aluminum Plant	Lan-chou, Kansu Province		27
	Sian Aluminum Plant	Sian, Shensi Province	60	100
	Others j/			80
	Total, Communist China		100	250
European Satellites				
Hungary	Inota Aluminum Plant	Inota	30	30
	Ajka Aluminum Plant	Ajka	10	12
	Tatabanya Aluminum Plant	Tatabanya	10	12
	Total, Hungary		50	55
East Germany	VEB Elektrochemisches Kombinat	Bitterfeld	35	35
	Lauta Aluminum Plant	Lauta	0 h/	20
	Total, East Germany		35	55
Czechoslovakia	Ziar Aluminum Plant	Ziar nad Hronom	56	85
Poland	Skawina Aluminum Plant	Skawina	26 k/	45
	Konin Aluminum Plant	Konin	0 h/	30
	Total, Poland		26	75
Rumania	N.A.	Slatina	0 h/	20 to 30
Total			970	2,000 to 2,100

Table 7

Production of Aluminum in the Sino-Soviet Bloc, by Plant a/
1960 and 1965 Plan
(Continued)

[redacted] Because of rounding, components may not add to the totals shown. 50X1

[redacted] 50X1

c. Unless otherwise indicated, locations in the USSR are in the RSFSR.
d. At the end of 1960 it is estimated that the Nadvoytsy plant had the capacity to produce about 40,000 tons per year.
e. At the end of 1960 it is estimated that the Sumgait plant had the capacity to produce about 60,000 tons per year.
f. At the end of 1960 it is estimated that the Stalingrad plant had the capacity to produce about 100,000 tons per year.
g. At the end of 1960 it is estimated that the Stalinsk plant had the capacity to produce about 180,000 tons per year.
h. These plants were under construction in 1960 or are to be constructed during 1961-65.
i. Some production, probably very small, was achieved during December, 1960, in an experimental unit. The first electrolytic reduction unit had not yet begun operating at the end of the year.
j. Specifically, reduction plants have been identified at the following locations. Except for Ching-yuan, Hsia-ling, Nan-ch'ang-fang, and Tsam-kong, [redacted] the locations of these plants are shown on the map, inside back cover. 50X1

Ch'ang-ch'un	Hsia-ling	T'ai-yuan
Cheng-chou	Huan-pu	T'ang-shan
Ch'eng-tu	Kuei-yang	Tsam-kong
Ching-yuan	Nan-ch'ang-fang	Wu-han
Yung-jen (Ch'u-chou)	Pao-ting	Yang-ch'uan
Ho-fei	Peking (experimental)	

k. At the end of 1960 it is estimated that the Skawina plant had the capacity to produce about 45,000 tons per year.

alleviating labor supply problems, even though labor costs are not a major component of the total costs and even though labor requirements are relatively small. Because the problem of labor supply is more serious in the eastern regions, where skilled labor not only is in short supply but also is difficult to attract from other regions, 26/ greater emphasis is being given to mechanization and automation of the plants in those areas. The availability of large supplies of low-cost power in the eastern regions is a further inducement for more extensive application of mechanization and automation.

Although the USSR utilizes the standard electrolytic method of reducing alumina to aluminum in all plants now operating or under construction, a radically different technique, called electrothermal reduction,* may be instituted to extract aluminum from nonbauxite ore during 1961-65. In December 1960 a large experimental electrothermal unit began operating at the Irkutsk Aluminum Plant. In this unit, sillimanite ore is reduced directly to aluminum and silumin, the latter being an alloy of aluminum and silicon. The new reduction method is alleged by Soviet authors to result in substantial savings in investment outlays, in labor, and in power costs and hence in lower average costs of producing both primary aluminum and silumin. 28/ The construction during 1961-65 of two similar units, one at the Stalingrad plant and the other at the Zaporozh'ye plant, is planned. 29/ Electrothermal reduction on an industrial scale also may be installed at Irkutsk and other locations, possibly before the end of the current planning period, to supplement the capacity for electrolytic reduction of aluminum from alumina. Success in this venture would broaden the resource base of the Soviet aluminum industry substantially, by moving sillimanite ore from the category of low-quality ores considered to be too costly to process into the category of economically processable ore.

European Satellite plans for 1961-65 include the construction of about 100,000 to 110,000 tons of new reduction capacity, constituting about one-tenth of the total planned for the Bloc. About 70 percent of this new capacity will consist of three new plants -- one in Poland, another in East Germany, and the third in Rumania. The remaining 30 percent will be accounted for by expansion of the only existing Czechoslovak plant.

In the new Polish and East German plants, provisions have been made for the installation of modern equipment and for extensive use

* Although details are lacking for comparison, the electrothermal process probably is analogous to processes that are to be tested soon in the Free World. One of these, whereby bauxite will be reduced directly to aluminum by the use of electricity, is to be tested in Arivida, Quebec, in a plant scheduled for completion in 1962. 27/

of mechanization and automation. For example, the cells to be installed in the Konin plant in Poland 30/ and the Lauta plant in East Germany* are designed to operate at 120,000 to 130,000 amperes. In contrast, the Skawina plant in Poland uses 60,000 ampere cells, and the Bitterfeld plant in East Germany uses 32,000 ampere cells. 32/ According to the Polish press, processes are to be partly automated and televisional techniques are to be employed at the Konin plant. 33/ Emphasis on mechanization and automation in the East German aluminum industry is implied by the announced general goals for raising labor productivity.

China plans to construct about 150,000 tons of new reduction capacity during 1961-65, or about one-sixth of the total planned by the Bloc. Of the new capacity planned, at least a predominant share is to be obtained by expanding the reduction plants located at Sian, Kuei-yang, Lan-chou, Huan-pu, and Ho-fei. These five plants, at which small sections began operating either in 1959 or early in 1960, are to produce a combined total of about 240,000 tons of aluminum annually some time after 1965. 34/

In sharp contrast to the Soviet and European Satellite programs, the Chinese Communist construction program apparently consists of provisions for installation of very small reduction cells and for virtually no mechanization or automation. The proposed reduction cell, designed to operate at a current load of about 5,000 amperes and to produce about 12.5 tons annually, is of the same type that was installed in the other plants constructed in China since 1957. 35/

The decision of the Chinese Communists to install small reduction cells rather than the larger cells of more advanced design is attributed to several factors. One of the most important factors is reported to be the much smaller requirements for capital investment associated with the use of smaller cells, 36/ and another is reported to be a shorter time period required for bringing new capacity into operation. 37/ Certainly the shortage of skilled labor, technicians, and engineers on the one hand and the large pool of cheap, unskilled labor on the other also is a factor. As a final consideration, the small cells provide greater flexibility in responding to changes in the supply of power.

b. Production of Alumina

During 1961-65, about 95 percent of the increment in production of alumina is planned to come from new capacity. Of this new

50X1

capacity, about 65 percent will consist of new plants, the majority of which are intended to process nonbauxite ores by new technologies. The remaining 35 percent of new capacity is to be obtained by expansion and modernization of existing alumina plants, primarily the largest plants. In general, the Bloc plans to install advanced equipment and, except in Communist China, to use mechanization and automation extensively.

The USSR plans to construct about 1.5 million to 1.7 million tons of new capacity for producing alumina during 1961-65, or about 80 percent of the total planned for the Bloc. About 65 to 70 percent of this new capacity is represented by four plants that are under construction -- large plants at Pavlodar and Achinsk in the eastern regions and smaller plants at Kirovabad and Razdan in the Caucasus. About 30 to 35 percent of the new capacity planned is to be obtained by expansion and modernization of existing plants. Table 8* shows the estimated 1965 goals for production in these plants.

The most modern equipment and technology are to be utilized in the new Soviet alumina facilities. For example, large modern processing units, such as rotary furnaces that are four to five times as productive as current models and grinding mills that are three times as productive as standard models, are planned for installation. 38/ Newly developed processes such as fluo-solid roasting (which is said to be much more efficient than earlier processes) also are to be used. 39/ In addition, the extensive application of mechanization and automation, particularly at the new plants in the eastern regions, is planned. 40/

New technologies designed for processing nonbauxite ore are to be used in much of the new capacity planned by the USSR for 1961-65. Of the four alumina plants under construction, only the Pavlodar plant is intended to process bauxite. The Achinsk plant will process nepheline; the Kirovabad plant, alunite; and the Akhtinsk plant, nepheline syenite. Moreover, the USSR probably plans to expand capacity at the Pikalevo plant and possibly at the Volkhov plant, both of which produce alumina from nepheline concentrate, and the Soviet planners evidently also are considering the conversion of the Tikhvin Alumina Plant from bauxite to nepheline concentrate. 41/ Finally, an experimental unit under construction at the Pavlodar plant is designed to extract alumina from nepheline syenite, 42/ large reserves of which are found nearby. If this unit proves to be successful, the Pavlodar plant probably will extract alumina from both bauxite and nepheline syenite. Any sillimanite exploited on an industrial scale by the Soviet aluminum industry before the end of the current planning period probably will be used for direct reduction to metal rather than for production of alumina.**

* Table 8 follows on p. 26.
** Text continued on p. 28.

Table 8

Production of Alumina in the Sino-Soviet Bloc, by Plant a/
1960 and 1965 Plan

Thousand Metric Tons

Country	Economic Region b/	Plant	Location c/	Basic Raw Material	Production 1960	Production 1965 Plan
USSR	Ia (Northwest)	Tikhvin Alumina Plant	Boksitogorsk, Leningradskaya Oblast	Bauxite	50	50
		Pikalevo Alumina Plant	Pikalevo, Leningradskaya Oblast	Nepheline Concentrate	50	100
		Volkhov Aluminum Plant	Volkhov, Leningradskaya Oblast	Nepheline Concentrate	50	50
	III (South)	Dnepr Aluminum Plant	Zaporozh'ye, Zaporozhskaya Oblast, Ukrainian SSR	Bauxite	150	200
	V (Transcaucasus)	Akhtinsk Mineral-Chemical Combine	Razdan, Armenian SSR	Nepheline Syenite	0 d/	100
		Kirovabad Alumina Plant	Kirovabad, Azerbaydzhan SSR	Alunite	0 d/	200
	VIII (Urals)	Bogoslovskiy Aluminum Plant	Krasnotur'insk, Sverdlovskaya Oblast	Bauxite	500	600
		Urals Aluminum Plant	Kamensk-Ural'skiy, Sverdlovskaya Oblast	Bauxite	500	600
	Xa (Kazakhstan)	Pavlodar Aluminum Plant	Pavlodar, Pavlodarskaya Oblast, Kazakh SSR	Bauxite	0 d/	500
	XI (East Siberia)	Achinsk Alumina Plant	Achinsk, Krasnoyarskiy Kray	Nepheline	0 d/	500
		Total, USSR			1,400	2,900 to 3,100

Table 8

Production of Alumina in the Sino-Soviet Bloc, by Plant a/
1960 and 1965 Plan
(Continued)

Thousand Metric Tons

Country	Plant	Location	Basic Raw Material	Production 1960	Production 1965 Plan
Communist China	Nan-ting Alumina Plant	Nan-ting, Shantung Province	Shale and clay	70	70
	Fu-shun Aluminum Plant	Fu-shun, Liaoning Province	Shale and clay	10	10
	Others		Shale and clay	120	420
	Total, Communist China			200	500
European Satellites					
Hungary	Almasfuzito Alumina Plant	Almasfuzito	Bauxite	120	220
	Ajka Aluminum Plant	Ajka	Bauxite	62	
	Mosonmagyarovar Alumina Plant	Mosonmagyarovar	Bauxite	35	35
	Total, Hungary			218	250
East Germany	VEB Chemiewerk Lauta	Lauta	Bauxite	60	60
Czechoslovakia	Ziar Aluminum Plant	Ziar nad Hronom	Bauxite	110	170
Rumania	N.A.	N.A.	Bauxite	0 d/	40 to 60
Total				2,000	4,000 to 4,100

[redacted] Because of rounding, components may not add to the totals shown.

[redacted]

c. Unless otherwise indicated, locations in the USSR are in the RSFSR.
d. These plants were under construction in 1960 or will be constructed during 1961-65.

50X1
50X1

Although the use of nonbauxite ore for production of alumina poses several problems, the Soviet planners apparently believe that the disadvantages of using nonbauxite ore have been overcome. Output of a variety of useful byproducts is foreseen in the USSR as compensating for some of the difficulties associated with the use of nonbauxite ore. At the Achinsk plant, where nepheline is to be processed, for example, with each ton of alumina Soviet planners expect to obtain about 300 kilograms (kg) of caustic soda, 100 kg of potassium sulfate, 20 kg of soda-potash, and 6 to 9 tons of slime suitable for use in producing high-quality portland cement. 43/ Byproducts expected from processing other nonbauxite ores include sulfuric acid, yerevanite (a raw material for producing high-quality crystalline glass), semiconductor-grade silica, and certain rare elements. 44/ Furthermore, Soviet planners expect that the cost of many of these byproducts will be lower than the cost of producing them conventionally. 45/

The European Satellites plan to construct about 100,000 to 120,000 tons of new capacity for producing alumina, or about 5 percent of the total planned by the Bloc. From 50 to 60 percent of the new capacity planned by the European Satellites is to be obtained by expansion and probably by modernization of the Ziar plant in Czechoslovakia and the Almasfuzito plant in Hungary, the two largest alumina plants in the European Satellites. The remainder is represented by a new plant planned by Rumania. Although construction plans probably include installation of modern equipment and extensive use of mechanization and automation, the basic technology of producing alumina is expected to remain essentially unchanged during 1961-65.

In Communist China, construction of about 300,000 tons of new capacity for producing alumina, or about 15 percent of the total planned by the Bloc, is planned during 1961-65. Presumably all of the new capacity is to be obtained by expansion and probably by modernization of existing plants. A predominant share of this expansion and modernization may be designated for a comparatively small number of alumina plants or departments committed to supplying the reduction plants at Sian, Kuei-yang, Lan-chou, Huan-pu, and Ho-fei, which are to be expanded considerably during 1961-65.

c. Mining

The Bloc will have to construct about 8 million to 9 million tons of capacity for mining aluminum-bearing ore during 1961-65, assuming that domestic supplies of ore are to be relied on entirely during that period. Such expansion would increase the total capacity to about 230 to 240 percent of the mining capacity that existed in the Bloc in 1960. The USSR probably will account for almost 80 percent of the increment in mining capacity, Hungary and Communist China will contribute

approximately equal shares of practically all of the remainder, and a very small share will be accounted for by Rumania.

In the USSR the addition to mining capacity is to be achieved partly by expansion of existing mines and partly by construction of new mines during 1961-65. Probably about one-half of the planned increase in mining capacity is to be attained by expansion of the bauxite mines in the Urals Region. Most of the remainder is to be represented by four new strip mines that are under construction. The general locations of the new strip mines, and the types of ore to be mined at those locations, are as follows:

Location	Type of Ore
Turgay, Kazakh SSR	Bauxite
Uzhur, Krasnoyarskiy Kray	Nepheline
Zaglik, Azerbaydzhan SSR	Alunite
Akhta, Armenian SSR	Nepheline syenite

Should results from an experimental production unit now in operation at Irkutsk and another under construction at Pavlodar be considered by Soviet planners to be favorable, additional capacity for strip mining sillimanite near Irkutsk and nepheline syenite near Pavlodar will be constructed.

2. Prospects for Construction

Probable continued improvements in construction performance should result in completion of most of the construction goals planned for 1961-65 in the aluminum industry of the Bloc. Some underfulfillment of construction plans may occur in Poland and Rumania, but such shortfalls would not significantly affect the over-all achievements of the Bloc. On the other hand, Soviet and European Satellite plans for mechanization and automation and Soviet plans for installation of rectifiers of advanced design probably will be substantially underfulfilled because of continued shortages in the supply of equipment.

In the USSR, recent construction performance has varied sharply among projects of the aluminum industry. On some projects, because of errors in planning and of shortages in supplies of production and construction equipment, materials, labor, and power, construction has lagged. For example, the plan for construction and assembly at the new aluminum-alumina plant at Pavlodar was underfulfilled by 29.2 percent in 1959 and by 49 percent in the first 5 months of 1960. 46/ On other projects, construction has proceeded as scheduled or even faster. To illustrate, construction of each of the first three reduction buildings of the

Sumgait Aluminum Plant took 2 years, but construction of the fourth took only 7 months. 47/ As a result, the Sumgait plant expects to attain by 1963 the level of production that had been planned for 1965. 48/ Similarly, construction of each of the first two reduction buildings of the Stalingrad Aluminum Plant took about 18 months, but construction of the third took only 7 months, 1 month less than scheduled. 49/ On balance, however, construction of projects for the aluminum industry in the USSR definitely has been behind schedule.

For 1961-65, the outlook for expansion of capacity in the Soviet aluminum industry is better. The large projects have been under construction for several years -- those at Pavlodar, Krasnoyarsk, Achinsk, and Irkutsk are carryovers from the Sixth Five Year Plan (1956-60) -- so that most of the buildup of the construction base for these projects probably has been completed. Moreover, the present construction schedules are more reasonable than those established earlier. Although inadequate supplies of some important building materials may continue to handicap construction operations, supplies of cement at several construction sites should improve, inasmuch as cement is to be a byproduct of the exploitation of nonbauxite ore during the latter part of the current planning period. Supplies of construction equipment should be improved more than envisioned earlier because of the recent supplemental allocation for investment in the construction equipment industry. 50/ To supplement its own output of production equipment, the USSR plans to import equipment from France. 51/ In addition, a share of the large quantity of production equipment that is to be imported from the European Satellites may be earmarked for projects of the aluminum industry. 52/

As a result, during 1961-65 the USSR probably will succeed in expanding the capacity for refining alumina and for reducing aluminum as planned but probably will not succeed in similarly expanding the capacity for mining. Soviet ore may have to be supplemented by imports, probably in the form of bauxite from Greece, as in the past. A more speculative possibility is that the USSR will begin importing bauxite from Guinea or Ghana, both of which have huge reserves of high-grade ore that could be substituted advantageously for the comparatively lower quality Soviet ores, particularly those of the nonbauxite varieties.

The outlook for realization of the planned additions to capacity for 1961-65 also is considered to be generally favorable both in China and in the European Satellites. In 1959, China constructed about 24 small aluminum reduction plants having a combined capacity of more than 25,000 tons annually. To achieve the goals set for 1965, the required annual rate of additions to capacity is not much greater than that achieved in 1959. In the European Satellites the probable continuation of the generally rapid rates of economic growth, combined with support from the USSR, 53/ should augment the chances of fulfillment of the planned expansions. Some parts of the European Satellite program, however, may

not be completed. First, the reduction plant that is to be constructed at Konin, Poland, probably will not be completed until late in 1965. Second, the capacity for producing ore, alumina, and aluminum planned by Rumania is not likely to be completed as scheduled during 1961-65. In fact, it is doubtful that Rumania will produce any aluminum at all by 1965.

Although plans by the Bloc for adding capacity in the aluminum industry during 1961-65 are expected to be fulfilled generally, Soviet and European Satellite plans for extensive mechanization and automation and Soviet plans for installation of semiconductor rectifiers of advanced design may be significantly underfulfilled. The equipment needed to implement these plans probably will continue to be in short supply during 1961-65. Failure of plans for mechanization and automation would result in underfulfillment of goals for labor productivity, both in the USSR and in the European Satellites. In the USSR, failure to provide rectifiers of advanced design would mean somewhat higher investment outlays than planned and larger consumption of electric power than anticipated.

D. Increased Production from Existing Capacity

In addition to the increments in production of aluminum and alumina that are to be obtained from new capacity, some gains in production from existing capacity during 1961-65 also are provided for in Bloc plans and probably will be realized. About 80,000 tons of aluminum, or about 8 percent of the total increment planned for 1961-65, are to be obtained by more efficient use of existing capacity, by improvements in supply, and by better organization of production. The USSR is to account for about 94 percent and Hungary for the remaining increment in production of aluminum expected from existing capacity. Similarly, about 130,000 tons of alumina, or more than 5 percent of the total increment planned for 1961-65, is to be obtained by more intensive and efficient use of existing capacity. Of the added production of alumina expected from existing capacity during 1961-65, the USSR is to contribute about 75 percent and Czechoslovakia the remaining 25 percent.

III. Trade

The Sino-Soviet Bloc became a net exporter of aluminum in 1955, and in 1959 its net exports amounted to 17,400 tons. The Bloc may cease to be a net exporter, however, before the end of the period 1961-65, even though large increases in output for that period are planned. The principal exporter of aluminum to the Free World, the USSR, has planned to increase domestic consumption and has agreed to provide much larger quantities of aluminum to the European Satellites during 1961-65. The plans of Communist China for increased consumption preclude the possibility of

Chinese exports of aluminum to the Free World. Indeed, China probably will continue to rely on markets of the Free World to satisfy a part of its internal requirements during 1961-65.

A. 1959-60

In 1959, and probably in 1960, the Bloc was a net exporter of aluminum essentially because of surplus production in the USSR. In 1959, the total exports by the Bloc to the Free World were 42,400 tons, whereas the total imports were only 25,000 tons, leaving a net export of about 17,400 tons. In 1960 the Bloc probably had a net export of about the same size. Data on trade in aluminum between the Bloc and the Free World in 1959 are shown in Table 9.*

Although the Bloc as a whole was a net exporter of aluminum in 1959, individual countries found imports necessary to meet requirements. In that year, five Bloc countries had no domestic production, and East Germany, Poland, and Communist China supplemented production with imports. The deficits among the European Satellites in 1959 were offset by imports that originated almost entirely within the Bloc, mainly from the USSR and Hungary. The deficit in Communist China in 1959, on the other hand, was offset by imports that originated almost entirely in the Free World. Data on the origin and disposition of supplies among the Bloc countries in 1960 are not available, but the situation probably was generally similar to that in 1959, as shown in Table 10.**

Soviet exports of aluminum to the Free World in 1959 continued a trend that began in 1955 when the goal of the Fifth Five Year Plan (1951-55) for production of aluminum was exceeded by about 6.5 percent. The USSR exported an average of about 29,400 tons annually to the Free World and imported an average of only 1,400 tons annually during 1955-59.***

B. Prospects for 1961-65

The quantities of aluminum available for export by the Bloc to the Free World during 1961-65 probably will be smaller than those available during 1959-60. Under current plans, production of aluminum is to rise to about 2.0 million to 2.1 million tons in 1965 compared with about 970,000 tons in 1960, but this increase will be necessary to provide the supplies of aluminum needed for Bloc programs. In the USSR, for example, more than 1 million tons of aluminum are earmarked for use in the construction of electric power transmission systems during 1959-65. 55/

* Table 9 follows on p. 33.
** Table 10 follows on p. 34.

50X1

Table 9

Trade in Aluminum Between the Sino-Soviet Bloc and the Free World a/
1959

Thousand Metric Tons

Exports				Imports					
	Origin				Destination				
Destination	USSR	Czechoslovakia	Total	Origin	Communist China	Bulgaria	Rumania	Poland	Total
Belgium	2.8	0	2.8	Austria	0.4	0	0.5	0.2	1.1
England	17.1	0	17.1	Benelux	0.3	0	0	0.2	0.4
Finland	6.8	0	6.8	Canada	9.4	0.2	0	1.2	10.8
Greece	0.2	0	0.2	France	0.8	0	0	0	0.8
India	1.0	0	1.0	Italy	0.3	0	0	0	0.3
Netherlands	6.5	0	6.5	Norway	7.8	0	1.1	2.0	11.0
West Germany	0	7.6	7.6	Switzerland	0	0	0	0.7	0.7
Yugoslavia	0.3	0	0.3						
				Total	18.9	0.2	1.7	4.2	25.0
Total	34.7	7.6	42.4						

a. [redacted] Because of rounding, components may not add to totals shown. 50X1

Table 10

Supply and Disposition of Primary Aluminum in the Sino-Soviet Bloc a/
1959

Thousand Metric Tons

Country or Area	Supply					Disposition			
		Imports c/					Exports d/		
	Production b/	USSR	Hungary	Free World	Total	Internal Use	To the Bloc	To the Free World	Production as a Percent of Internal Use
USSR	600.0		0	0	600.0	515.0	50.3	34.7	116
Communist China	70.4	1.3	0	18.9	90.6	90.6	0	0	78
North Korea and North Vietnam	0	0.6	0	0	0.6	0.6	0	0	0
European Satellites	144.6	48.4		6.0	199.0 e/	191.4		7.6	76
Hungary	45.7	0		0	45.7	37.4	8.3	0	122
East Germany	35.1	30.0	6.4	0	71.5	71.5	0	0	49
Czechoslovakia	41.0	6.6	0	0	47.6	40.0	0	7.6	102
Poland	22.8	5.4	1.9	4.2	34.3	34.3	0	0	67
Rumania	0	4.7	0	1.7	6.3	6.3	0	0	0
Bulgaria	0	1.7	0	0.2	1.9	1.9	0	0	0
Albania	0	0	0	0	0	0	0	0	0
Total	810.0			25.0	840.0	797.6		42.4	102

a. Trade within the Bloc included rolled aluminum, duraluminum, and bare aluminum wire as well as primary aluminum. Because of rounding, components may not add to the totals shown.
b. Data shown in this column are taken from Table 1, p. 6, above.

50X1

e. This figure includes 48,400 metric tons of intra-Bloc trade from the USSR, and this quantity should be excluded in arriving at a total supply of the Bloc.

This allocation partly reflects the plans to use aluminum as a substitute for about 300,000 tons of lead in cable sheathing and about 400,000 tons of copper in cable conductors. 59/ Similarly, aluminum is to be used as a substitute for substantial quantities of lead in storage batteries. Soviet planners expect that the use of aluminum and plastics combined will reduce the lead requirements of the cable and battery industries by about 100,000 tons in 1965 alone. 60/ The USSR plans to expand the use of aluminum in the manufacture of vehicles so that by 1965 the amount used per vehicle in the motor vehicle and tractor industries will be double the amount used in 1958. The USSR also plans to increase the use of aluminum in bearings, machinery, consumer goods, shipbuilding, and construction. 61/ Similar programs in the European Satellites 62/ are based in part on the promise of increased supplies of aluminum from the USSR, and thus the prospects for continued exports by the Bloc to the Free World are further decreased.

Specific plans for allocating aluminum among the countries of the Bloc during 1961-65 are not available, but the general pattern of allocation can be estimated. The bulk of Soviet production during 1961-65 probably will be used to satisfy internal requirements, with most of the remainder going to East Germany, Bulgaria, Albania, and possibly other European Satellites (for example, Poland and Rumania) that might suffer shortfalls in their production programs. The USSR has already agreed to supply 85,000 tons of aluminum to East Germany in 1965. 63/ Such a quantity is 69 percent greater than the total export by the USSR to all countries of the Bloc in 1959. The increased production of aluminum in the European Satellites and Communist China during 1961-65 is expected to be used indigenously. Both areas, however, may receive supplemental shipments from the USSR.

Communist China, the principal Bloc importer of aluminum from the Free World in 1959-60, is expected to become more nearly self-sufficient if its own production of aluminum increases as planned. In spite of rapidly rising requirements, the average quantity to be imported annually by China during 1961-65 may not differ significantly from the 19,000 tons imported in 1959. Thus the relative importance of imports to Communist China is expected to decrease during 1961-65.

IV. Investment

For each unit of investment outlay in the aluminum industry of the Bloc, the increments in capacity in 1961-65, although somewhat larger than in previous years, probably will be smaller than planned. As a result, supplemental funds may be needed to carry out the planned expansion of the aluminum industries of the Bloc. Because the expansion program apparently has been assigned a high priority, needed funds presumably will be allocated.

A. Total Investment

Investment data are available for only two countries, the USSR and Poland. The USSR allocated almost 20 billion rubles* to carry out the expansion planned for 1959-65, and Poland allocated 370 million zlotys** to effect the expansion planned for 1961-65. The investment allocation for the Soviet aluminum industry represents a much larger proportion of the total allocation for the nonferrous metals industry for 1959-65 than was true in 1952-58. The 20 billion rubles is 35 percent of the planned total of 55 billion rubles allocated to the Soviet nonferrous metals industry, 65/ whereas in 1952-58 the Soviet aluminum industry received only about 8 billion rubles,*** or about 25 percent of the total investment of about 30 billion rubles† in the nonferrous metals industry.

B. Average Investment Outlays

In both the USSR and Poland the planners expect that the average investment outlays per unit of capacity in their aluminum industries will be much smaller during 1961-65 than in previous years. Similar results probably are anticipated in other countries of the Bloc. Soviet planners expect that the cost for all capacity to be added in mining, alumina

* Pre-1961 rubles in 1955 prices. The figure was derived by multiplying the planned capital outlay per ton for 1959-65 (see IV, B, below), by the increment in production planned for 1959-65 (see Table 1, p. 6, above).

** This figure, expressed in 1958 prices, was obtained by multiplying the capital outlay of 12,200 zlotys per ton planned for the Konin plant (see IV, B, below), by the capacity of 30,000 tons planned for that plant in 1965 (see Table 7, p. 20, above). A much larger figure of 2.5 billion zlotys has been reported as the planned total investment for the Konin plant, 64/ but this figure apparently is the total cost of the complex planned for Konin, including not only reduction facilities but also fabricating facilities and possibly others. Also, it may cover reduction facilities and other capacity scheduled for construction after 1965.

*** This figure (X) was estimated by using the formula X = ABC, where A = 20,000 rubles, the average investment outlay per ton of capacity planned for 1959-65 (see IV, B, below), B = 1.25, the factor indicating the approximate ratio of unit investment outlays made in 1952-58 to unit outlays planned for 1959-65, based on the report that unit investment outlays planned for 1959-65 are 20 to 22 percent below actual outlays of 1952-58, 66/ and C = 320,000 tons, the increment in production achieved by 1958 (above 1951) [redacted] 50X1

† Derivation of this figure is based on the report that the total investment in nonferrous industry planned for 1959-65, 55 billion rubles, is 1.8 times the investment for 1952-58. 68/

refining, and aluminum reduction during 1959-65 will average about 20,000 rubles per ton. 69/ Such an investment outlay would be about 20 percent below the average for 1952-58. 70/ Polish planners expect that investment outlays per ton of new aluminum reduction capacity will average about 12,200 zlotys, or 13 percent less than the average investment outlay planned for the second section of the Skawina plant, which was completed in 1960, and 34 percent less than the actual average investment outlay for the first section of the plant, which was completed in 1954. 71/ A comparison of the capital outlays planned in the USSR and Poland with the average outlay in the US of about $1,650 per ton for all capacity for mining, alumina refining, and aluminum reduction (which included $880 for a ton of capacity for aluminum reduction) indicates a ruble-dollar ratio of about 12 to 1* and a zloty-dollar ratio of about 14 to 1, expressed in 1958 prices.

The reduction in average investment outlays planned by the USSR is to be accomplished by the construction of large strip mines and of plants having larger capacities, by the installation of larger equipment and of less expensive rectifiers, and by the expansion of capacities of existing plants, particularly by modernization. Installation of large reduction cells alone, according to a Soviet publication, 72/ reduces investment cost 12 to 13 percent. The planned reduction in average investment outlays per unit of capacity in Poland, and probably in other countries of the Bloc, reflects similar anticipated savings.

Although such reductions in average investment outlays for new capacity may be realized during 1961-65, the reductions probably will not be so large as the planners now anticipate. In the USSR, for example, the planned reduction rests in significant measure on investment costs for several large plants under construction in the eastern regions. The average investment outlay for one of these, the Krasnoyarsk Aluminum Plant, is expected to be 17 to 25 percent below that for other plants under construction in the country and 50 percent below that for existing plants. 73/ The expectation of such large reductions in investment costs in the eastern regions is considered to be visionary.

V. Average Cost of Production

The average cost of producing aluminum probably will decrease in the Sino-Soviet Bloc during 1961-65, continuing the general trend of 1950-60, but the reductions probably will not be so large as planned. The reductions projected for 1961-65 should result mainly from investment in more efficient equipment and modernization, from improvements in the quality of materials, from lower transportation costs brought about by better

* This ratio was calculated by assuming that the 1958 ruble prices did not differ appreciably from the 1955 ruble prices.

juxtaposition of plants and sources of supply, and from generally lower unit costs of power and fuel. Most of these factors also contributed to the reduction of costs achieved during 1950-60.

A. 1950-60

The average cost of producing aluminum in the Bloc is believed to have decreased progressively during 1950-60. In the USSR the average cost was reduced 30.5 percent during 1950-55 74/ and apparently continued to decrease during 1956-60.* In East Germany the average cost of production declined 16 percent during 1954-59. 76/ Reductions in the average cost of producing aluminum during 1950-60 are believed to have occurred also in Poland, Czechoslovakia, Hungary, and China, but their extent is not measurable with available data.

By 1958 the average cost of producing a ton of aluminum in the USSR was reduced to a level substantially below that for several other major nonferrous metals. In that year the average cost of producing a ton of aluminum was reported to be about 90 percent of that for copper, 65 percent of that for lead, and 5 percent of that for tin.** 77/

The approximate levels to which the average costs of producing aluminum were reduced in the USSR, East Germany, and China by 1960, together with the respective cost/US price ratios for 1960, are presented in the following tabulation. Because of insufficient data, estimates of costs in other countries of the Bloc have not been developed.

* The estimate that average costs decreased during 1956-60 is based on numerous reports of rising efficiency in the Soviet aluminum industry during 1956-58, particularly with respect to consumption of electric power, and on the report 75/ that average costs decreased during 1959-60.

** The relative cost of producing aluminum apparently was even less than is indicated in the comparison. One of the components of the cost of producing these metals, the cost of electric power, was calculated not on the basis of the rates charged for electric power but on the basis of the actual costs of producing the electric power. These actual costs are higher than the preferential rates charged to consumers of large quantities of electric power such as aluminum reduction plants. Thus the figure for the average cost of producing aluminum used in making the comparison was greater, by the difference between the preferential rate for electric power and the actual cost of producing the electric power, than the actual average cost of producing aluminum. The comparison therefore favored copper, lead, and tin, the production of which does not require large quantities of electric power.

Country	Average Cost per Metric Ton	Cost/US Price Ratio*
USSR	4,000 rubles**	7.0 : 1
East Germany	2,000 DME***	3.5 : 1
China	4,000 yuan†	7.0 : 1

The general downward trend of the average cost of producing primary aluminum in the USSR during 1950-60 came about mainly through decreased costs for alumina and electric power, each of which represents about 30 percent of the total cost. The reduction in the cost of alumina appears to have been rather large, judging from the reported reductions in the average cost of producing alumina at individual plants.†† A reduction of at least 12 percent in the cost of electric power per ton of aluminum during 1950-60 is indicated by the available information 81/ on the average consumption of electric power during 1950-59.

Lower costs for alumina and electric power, in turn, were brought about by a variety of factors. The reduction in the average cost of producing alumina in the USSR during 1950-60 resulted primarily from the following: (1) lower average costs for producing bauxite, brought about principally by investment in mechanization and improvements in organization, and (2) greater efficiency in using steam and fuel, primarily because of investment in more efficient processing units. 82/ The reduction in the average quantity of electric power consumed was brought about (1) by investment in more efficient reduction cells, (2) by replacement of motor converters with more efficient mercury-arc rectifiers, and (3) by improvements in the quality of electrolytes and anodes and in operating

* The US price used for deriving the ratios shown in this column is $573 per ton, based on the price of $0.26 per pound.

** 78/. Average costs may have been reduced to approximately this level as early as 1957. It is assumed, however, that costs have not decreased appreciably since 1957. The ruble valuation has not been adjusted for the 1 for 10 exchange that took place early in 1961.

*** Deutsche Mark East (East German marks). This figure is based on the assumption that costs in 1960 did not change appreciably from the level indicated for 1959 [redacted] 50X1

† This figure is a rough approximation derived by using available data on the consumption of electric power in reduction and on rates for electric power and on the proportion of the total cost represented by the cost of electric power in the Chinese aluminum industry.

†† The average cost of producing alumina was 29.2 percent lower at the Urals Aluminum Plant and 52.1 percent lower at the Bogoslovskiy plant in 1955 than in 1950 and was 27.2 percent lower in 1959 than in 1956 at the Dnepr Aluminum Plant. 80/

procedures. 83/ In view of the intra-Bloc cooperation in the nonferrous metals industries, 84/ these factors are presumed to have contributed to reductions in the average cost of producing aluminum in other Bloc countries as well.

B. Prospects for 1961-65

Throughout the Bloc, in a continuation of the general trend during 1950-60, the average cost of production of aluminum is planned to be lower in 1965 than in 1960. In the Seven Year Plan (1959-65) of the USSR the average cost of producing aluminum by 1965 is to be reduced 20 to 22 percent compared with 1958. 85/ Plans to reduce the average cost of producing aluminum in each of the European Satellites either have been announced or may be inferred from announced goals to reduce the cost of industrial production. 86/ The Chinese press declares that much emphasis is to be given to reducing the cost of producing aluminum. 87/

The sharp reduction planned by the USSR in the average cost of producing aluminum is predicated largely on several expected developments within the industry and on one important expected development outside the industry. Within the industry, reductions are anticipated in (1) the average quantity of electric power consumed per unit of aluminum produced, primarily through the use of improved reduction cells, rectifiers, electrolytes and anodes 88/; (2) the average cost of producing alumina, partly through investment in modernization and in equipment of advanced design, and partly through exhaustive exploitation of nonbauxite ores for by-products (for example, caustic soda, cement, and sulfuric acid) as well as alumina 89/; (3) the average cost of mining ore, as a result of lower labor and capital costs that are to be achieved by emphasis on strip mining 90/; and (4) the average freight cost, reflecting fewer ton-kilometers per ton of aluminum produced (by 1965 a decrease of 30 percent is expected from the level of 1957, because of improvements in the location of plants relative to sources of ore, coal, soda, and so forth). 91/

Economies of scale also are expected to result in further reductions in costs. The important development outside the industry is a reduction in the unit costs of electric power, fuel, and steam. This reduction reflects (1) an expected decrease in the average cost of producing fuels and electric power because of a shift of the fuel balance from coal toward the less costly oil and natural gas and (2) the expectation that average costs of fuel, steam, and particularly electric power in the eastern regions, where several large plants and mines are under construction, will be much lower than similar costs elsewhere in the country.

Varying combinations of the factors involved in reducing the cost of producing aluminum in the USSR will bring about reductions also

in the European Satellites and Communist China. Improved operating procedures, however, probably are expected to play a greater role in reducing average costs in the European Satellites and in China than in the USSR.

Soviet planners apparently expect that the average cost of producing aluminum will remain below that for other major nonferrous metals during 1961-65. At the same time, however, they expect some changes in the cost relationships for those metals. Along with a reduction of about 21 percent in the average cost of producing aluminum,* a reduction of about 15 percent in the average cost for lead 92/ and about 25 percent for copper 93/ is planned by 1965 compared with costs in 1958. Should these planned reductions be achieved, in 1965 the average cost of producing aluminum would be 94 percent of that for copper (compared with about 90 percent in 1958) and 61 percent of that for lead (compared with 65 percent in 1958).

The expectations of the Bloc for reduction of the cost of producing aluminum during 1961-65 appear to be optimistic. The European Satellites and Communist China probably will realize smaller reductions than are planned, and in the USSR also the decrease almost certainly will be much smaller than planned. Costs of producing fuel and power are not likely to be as low as now foreseen by Soviet planners, and, therefore, prices to the aluminum industry probably will be higher than now anticipated. The increased efficiency in the consumption of electric power probably will not be fully realized: plans to install semiconductor rectifiers of advanced design undoubtedly will fall short of realization because of continued shortages in supply, and plans to improve the quality of anode materials, necessitated by increasing reliance on carbon obtained from crude oil from the Urals and Volga regions, which has a high sulfur content, probably will not be fully realized. Furthermore, the average cost of producing alumina from nonbauxite ores almost certainly will be much higher than now foreseen by Soviet planners.

---

* The midpoint of the range of 20 to 22 percent.

APPENDIX A

METHODOLOGY

The figures in Tables 1, 3, and 5, rounded before presentation, were derived as follows:

1. Table 1*: Production of Primary Aluminum

a. USSR

1950: estimated by using the equation X = ABCD, where

X = the level of production in 1950;
A = 37,700 tons, production in 1937 94/;
B = 1.59, the factor relating production in 1940 to that in 1937 95/;
C = 1.44, the factor relating production in 1945 to that in 1940 96/; and
D = 1.80, the factor relating production in 1950 to that in 1945. 97/

1955: 2.77 times production in 1950. 98/

1958: 3.3 times production in 1950. 99/

1959: based on (1) the report that the total production of aluminum was 650,000 tons 100/ and on (2) the estimate that the total included about 50,000 tons of secondary aluminum. The estimate of production of secondary aluminum in 1959 based on (1) the estimate of 45,000 tons for production in 1958 101/ and on (2) the assumption that production of secondary aluminum increased about 5,000 tons in 1959.

1960: based on (1) the assumption that the increase in production planned for 1960 was about 16 percent, roughly the average annual rate of increase required to reach the level of production planned for 1965; on (2) the report that the level of production planned for 1960 was reached on 26 December 1960 102/; and on (3) the evidence in the Soviet press that new capacity was commissioned during the year. 103/

1965 goal: 2.8 to 3.0 times production in 1958. 104/

* P. 6, above.

b. Communist China

1955: based on (1) the annual capacity of China's one plant in the prewar period, 15,000 tons, 105/ and on (2) the assumption that that plant, restored late in 1954, operated at much less than full capacity during the first half of 1955.

1958: 70 percent of production in 1959, as indicated by the report that production in 1959 was 142 percent of that in 1958. 106/

1959: 107/

1960: based on (1) evidence that Communist China constructed 24 aluminum plants during 1959 108/ and on (2) the estimate that each of these plants is capable of producing about 1,000 tons per year and that all of them were fully operational by the beginning of 1960.

1965 goal: derived by adding the estimates of capacities of individual plants. Estimates of capacities of individual plants based on (1) reported planned designed capacity -- for example, 100,000 tons annually by the Sian plant 109/; on (2) past production achievements [redacted] and on (3) assumptions regarding the probable size of plants reported to be "small" or "large" -- for example, in the absence of other data, "small plants" are assumed to have a capacity of 1,000 to 2,000 tons a year. 50X1 50X1

c. European Satellites

(1) Czechoslovakia

1955: 111/

1958: 112/

1959: based on (a) production of 23,762 tons in the first 7 months 113/ and on (b) the assumption that the average monthly production in the remaining 5 months was the same as in the first 7 months -- that is, 23,762 + (3,394.6 x 5) = 41,000 tons.

1960: based on the assumption that the planned level of production 114/ was achieved.

1965 goal: 51 percent above production in 1960. 115/

(2) East Germany

1950: 116/

1955: 117/

1958: 118/

1959: 119/

1960: based on (a) the assumption that the level of production in 1960 did not change from that of 1959 and on (b) a lack of evidence that capacity changed.

1965 goal: based on (a) the estimated production of 35,000 tons in 1960 and on (b) the report that a new plant under construction at Lauta is designed to produce 20,000 tons per year. 120/

(3) Hungary

1950-59: 121/

1960: 122/

1965 goal: 123/

(4) Poland

1955-59: 124/

1960: 125/

1965 goal: 126/

(5) Rumania

1965 goal: 127/

2. Table 3*: Production of Alumina

a. USSR

1950: developed by assuming that production of alumina and requirements for alumina for production of aluminum are approximately equal. The requirement was estimated by assuming an approximate ratio of 2 to 1 for alumina to aluminum.

1955: 2.82 times production in 1950. 128/

1958: estimated requirement, derived by the same methodology as used for 1950, above.

1959: developed as the sum of (1) the estimated requirement for production of aluminum (see 1950, above) and (2) 10,000 tons, the quantity exported to Poland. 129/

1960: estimated requirement, derived by the same methodology as used for 1950, above.

1965 goal: developed as the sum of (1) the estimated requirement for production of aluminum (see 1950, above) and (2) 60,000 tons, the estimated planned export to Poland.

b. Communist China

1955: the sum of (1) 20,000 tons, the approximate requirement for production of aluminum, developed by assuming a ratio of 2 to 1 for alumina to aluminum, and (2) 10,000 tons, the estimated export of alumina, developed from incomplete data held in the files of this Office.

1958: the sum of (1) 100,000 tons, the estimated requirement for production of aluminum (see 1955, above, for the description of the methodology) and (2) 10,000 tons, the quantity exported. 130/

1959, 1960, and 1965 goal: estimated requirement for production of aluminum (see 1955, above, for the description of the methodology).

* P. 9, above.

c. European Satellites

(1) Czechoslovakia

1959, 1960, and 1965: developed by assuming that production of alumina and requirements for alumina for production of aluminum are approximately equal. The requirement was estimated by assuming an approximate ratio of 2 to 1 for alumina to aluminum.

(2) East Germany

1955, 1958, and 1959: 131/

1960: estimated by assuming that production was at about the level planned -- that is, 58,000 tons. 132/

1965 goal: 133/

(3) Hungary

1950, 1955, 1958, and 1959: 134/

1960: 135/

1965 goal: 136/

(4) Rumania

1965 goal: estimated by assuming that production of alumina and requirements for alumina for production of aluminum are approximately equal. The requirement was estimated by assuming an approximate ratio of 2 to 1 for alumina to aluminum.

3. Table 5*: Production of Aluminum-Bearing Ore

a. USSR

1950: 43 percent of the production of bauxite in 1955, as indicated by the report that production in 1955 was 2.33 times that in 1950. 137/

* P. 12, above.

1955: Bauxite: estimated production, derived by using the equation X = [A - (B + C + D)] E, where

X = the total production of bauxite;
A = 870,000 tons, the estimated total production of alumina;
B = 65,000 tons, the estimated quantity of alumina produced from 200,000 tons of bauxite imported from Hungary, 138/ assuming an approximate ratio of 3 to 1 for ore to alumina;
C = 35,000 tons, the estimated quantity of alumina produced from 122,000 tons of bauxite imported from Greece, 139/ assuming an approximate ratio of 3.5 to 1 for ore to alumina;
D = 30,000 tons, the estimated quantity of alumina produced from nepheline concentrate 140/; and
E = 3.5, the approximate ratio of bauxite to alumina, based on the estimated ratio of 7 to 1 for bauxite to aluminum. 141/

Nepheline concentrate: estimated quantity required for the production of 30,000 tons of alumina at the Volkhov plant, 142/ using the reported ratio of 4 to 1 for concentrate to alumina. 143/ Nepheline concentrate was the only aluminum-bearing ore used by the Volkhov plant, and this plant was the only one in the aluminum industry of the USSR that used nepheline concentrate.

1958: Bauxite: estimated production, derived by using the equation X = [A - (B + C)] D, where

X = the total production of bauxite;
A = 1.03 million tons, the estimated quantity of alumina produced;
B = 130,000 tons, the estimated quantity of alumina produced from 450,000 tons of bauxite imported from Greece, 144/ assuming a ratio of 3.5 to 1 for ore to alumina;
C = 40,000 tons, the estimated quantity of alumina produced from nepheline concentrate 145/; and
D = 3.5, the approximate ratio of bauxite to alumina.

Nepheline concentrate: derived by the same methodology as that for 1955. The output of alumina at the Volkhov plant in 1958 was 40,000 tons. 146/

1959: Bauxite: estimated production, derived by using the equation X = [A - (B + C)] D, where

X = the total production of bauxite;
A = 1.21 million tons, the estimated production of alumina;
B = 130,000 tons, the estimated quantity of alumina produced from 454,000 tons of bauxite imported from Greece, 147/ assuming an approximate ratio of 3.5 to 1 for ore to alumina;
C = 80,000 tons, the estimated quantity of alumina produced from nepheline concentrate; and
D = 3.5, the approximate ratio of bauxite to alumina.

Nepheline concentrate: derived by the same methodology as that for 1955. The output of alumina at the Volkhov and Pikalevo plants in 1959 is estimated to have been 80,000 tons.

1960: Bauxite: estimated production, derived by using the equation X = [A - (B + C)] D, where

X = the total production of bauxite;
A = 1.4 million tons, the estimated production of alumina;
B = 120,000 tons, the estimated quantity of alumina produced from 432,000 tons of bauxite imported from Greece, 148/ assuming a ratio of 3.5 to 1 for ore to alumina;
C = 100,000 tons, the estimated quantity of alumina produced from nepheline concentrate; and
D = 3.5, the approximate ratio of bauxite to alumina.

Nepheline concentrate: derived by the same methodology as that for 1955. The output of alumina at the Volkhov and Pikalevo plants in 1960 is estimated to have been 100,000 tons.

1965: Bauxite: estimated goal for production of bauxite, derived by using the equation X = (A - B) C, where

X = the production of bauxite;
A = 2.9 million to 3.1 million tons, the estimated goal for the total production of alumina;
B = 640,000 to 680,000 tons, the estimated quantity of alumina to be produced from nonbauxite ore; and
C = 3.5, the approximate ratio of ore to alumina.

Nonbauxite ore: estimated goal for production, based on (1) the sum of estimated levels of production of alumina planned for the plants at Volkhov, Pikalevo, Razdan, and Achinsk that are to process nephelines and for the plant at Kirovabad that is to process alunite and on (2) an approximate ratio of 5 to 1 for ore to alumina. The basis for using this ratio is the estimate that the average ratio of ore to alumina for the four nepheline processing plants will be in the range of 4 or 5 to 1, close to the actual ratio reported for the Volkhov plant, and the information that, for alunite, the ratio of ore to alumina is 6.7 to 1. 149/

b. Communist China

Estimated production of aluminum-bearing ore, developed by assuming that production of ore and the requirements for ore for production of alumina are approximately equal. The requirement was developed by assuming an approximate ratio of 3.5 to 1 for ore to alumina, based on the report of the experience of Japan before World War II in using the shale and clay found in Communist China for producing aluminum. 150/

c. European Satellites

(1) Hungary

1950, 1955, 1958, and 1959: 151/

1960: 152/

1965 goal: 153/

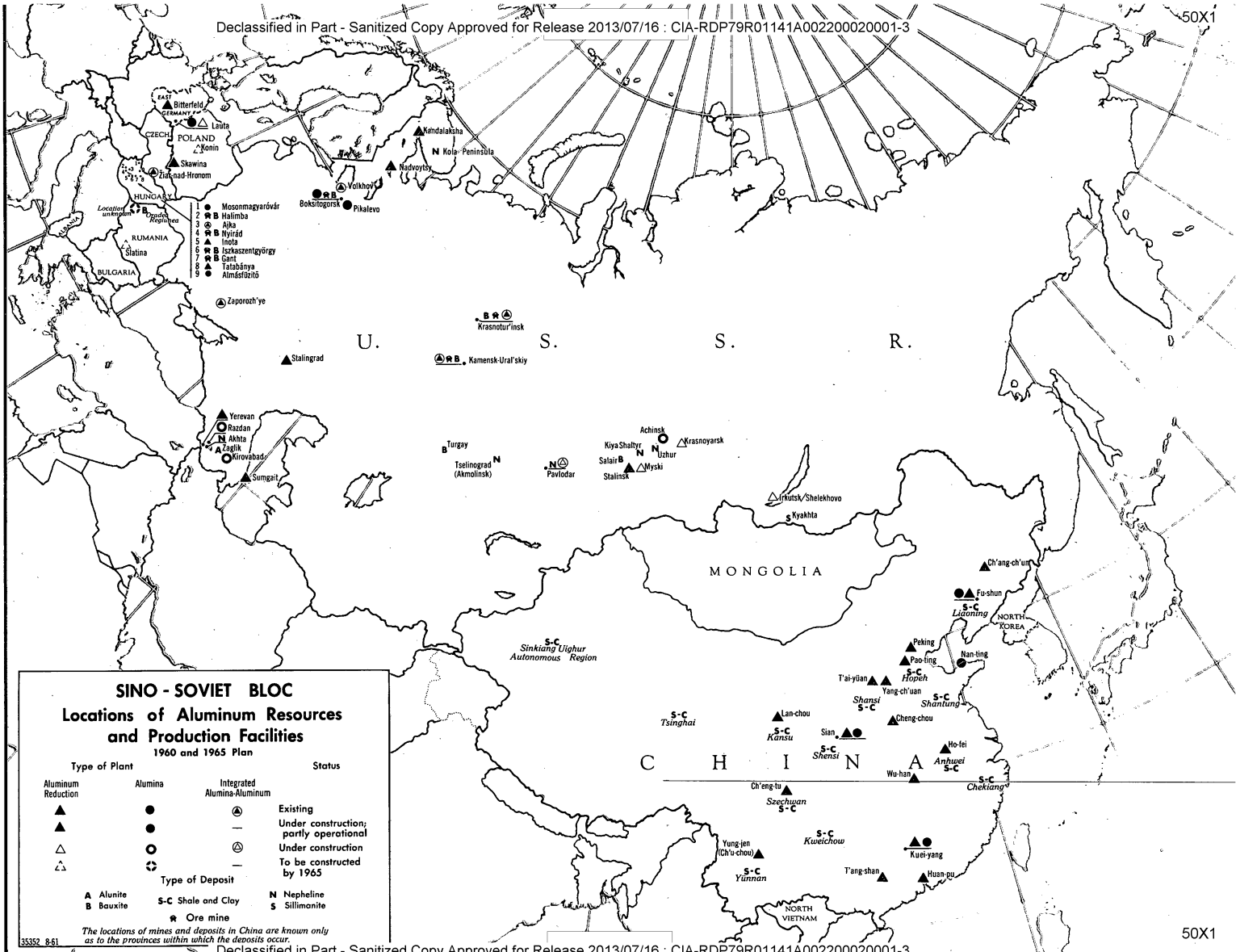
(2) Rumania

Goal for production of bauxite in 1965 for the aluminum industry, developed by assuming that production of ore and the quantity of ore required to achieve the level of production of primary aluminum planned for 1965, 20,000 to 30,000 tons, are approximately equal. The requirement was calculated by using an approximate ratio of 7 to 1 for ore to aluminum. Available information indicates that bauxite produced by Rumania during the period 1950-60, most of which was exported, was used for such products as abrasives rather than for aluminum. For this reason the estimated production of Rumania during 1950-60 was not

included in the Bloc totals, but is shown (for selected years) in the following tabulation:

Year	Tons	Year	Tons
1950	9,000	1959	90,000
1955	50,000	1960	100,000
1958	80,000		

Next 8 Page(s) In Document Denied



SINO - SOVIET BLOC
Locations of Aluminum Resources and Production Facilities
1960 and 1965 Plan

Type of Plant

Aluminum Reduction	Alumina	Integrated Alumina-Aluminum	Status
▲	●	◬	Existing
▲	●	—	Under construction; partly operational
△	○	◬	Under construction
△	○	—	To be constructed by 1965

Type of Deposit

A Alunite
B Bauxite
S-C Shale and Clay
N Nepheline
S Sillimanite
Ore mine

The locations of mines and deposits in China are known only as to the provinces within which the deposits occur.

35352 8-61